

## **USDA Hurricane Mitch Recovery Program**

### **Special Objective 1—**

*Damaged Rural Watersheds Rehabilitated through Strengthened Local Capacity.*

## **SECTION II: DETAILED SpO 1 ACTIVITIES BY COUNTRY**

### **C. Country Program Description--Guatemala**

#### **Program Background and Objectives**

The *Sierra de las Minas* is a mountain range (figure 1) located in eastern Guatemala (figure 2) that rises to heights of more than three thousand meters above sea level. Bordered on the north and south by the Polochic and Motagua river valleys, a part of the mountain range known as the *Sierra de las Minas* Biosphere Reserve (SMBR) extends approximately 130 kilometers in length and varies from 10 to 30 kilometers in width.



**Figure 1. *Sierra de las Minas* Range, Guatemala**

Sixty-three streams flow off the slopes of the Sierra into the river valleys below providing a range of hydrological services for 11 municipalities in and adjacent to the reserve. Hydrological services include domestic water supplies, commercial and subsistence agriculture, hydropower generation, and maintenance of biodiversity, including the *Bocas de Polochic* Wildlife Reserve, which is a Ramsar site adjacent to Lake Izabal

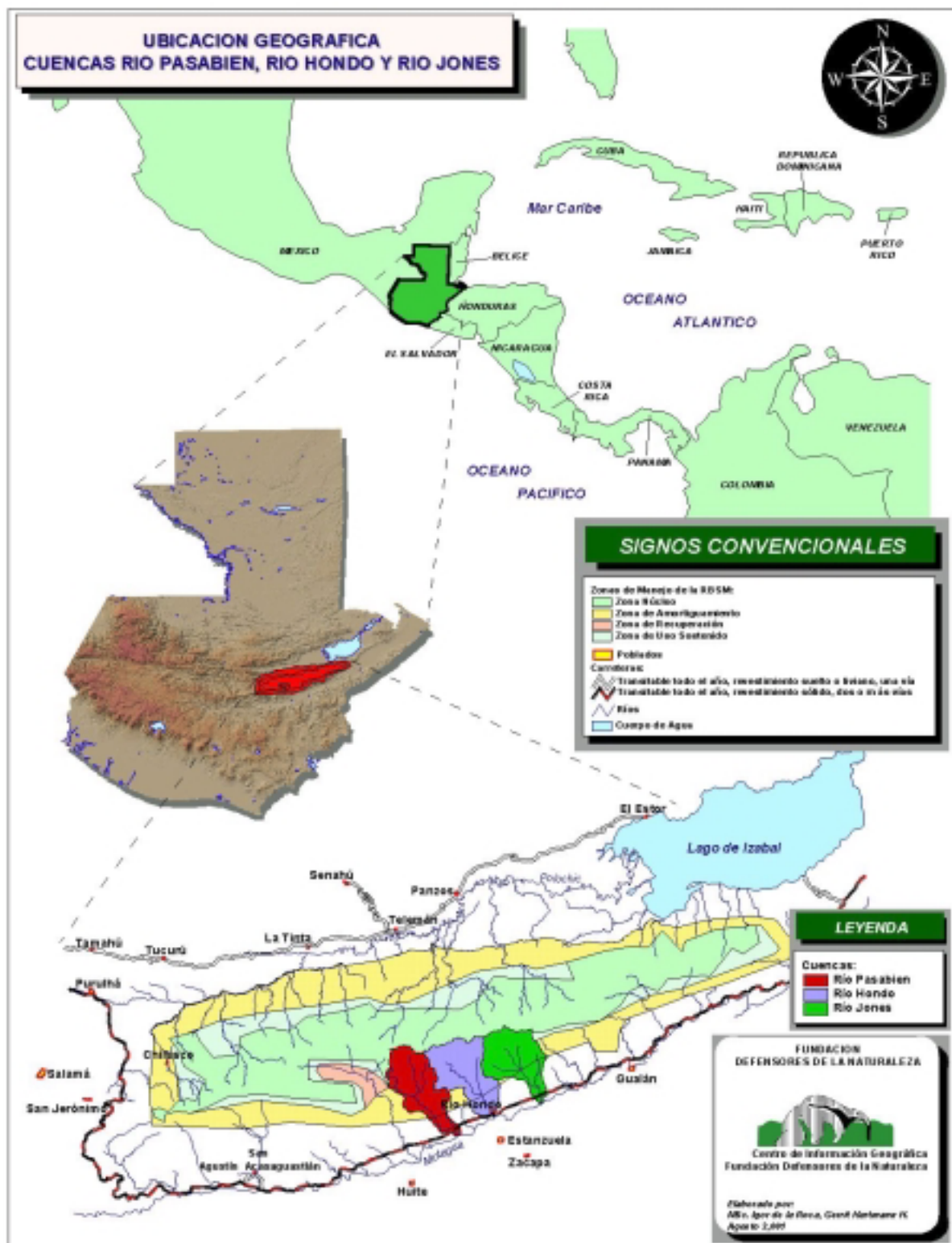


Figure 2. Location of project site in Guatemala

just northeast of the Reserve. Additional communities further removed from SMBR rely upon waterflows draining into the Polochic and Motagua rivers.

These hydrological services were significantly disrupted by Hurricane Mitch in October of 1998. In Guatemala, as elsewhere, the relatively poor state of the natural environment, particularly in the uplands, contributed greatly to the devastation in the lowlands and valleys. Along the southern flank of the Sierra, made vulnerable by annual wildfires and overgrazing, the damage was particularly severe. In addition to crop losses and the loss of agricultural land along stream courses, Mitch caused landslides (figure 3), created newly eroded surfaces, and degraded agricultural lands.



**Figure 3. Photo of a large high elevation landslide in the *Sierra de las Minas* range. Landslides are sources of sediment, which contribute to ongoing damage in lower elevation agricultural zones after rainstorms.**

Numerous landslides are the source of extremely high sediment loads that continue to cause damage to infrastructure and agricultural activities during even normal rainfall events. Increasingly it is recognized within Guatemala that lowland agriculture and infrastructure depend upon the quality of watershed management in the uplands.

Consistent with its programmatic focus in other countries, USDA identified rehabilitation of individual watersheds as the focal point of its reconstruction effort since it is the quality of watershed management which affects the ability of the land to regulate water runoff, conserve scarce soil and forest resources, protect rural infrastructure, and provide for the myriad of products and environmental services required by an agricultural economy.

### **Results Framework**

Special Objective 1 (SpO 1), *Damaged Rural Watersheds Rehabilitated through Strengthened Local Capacity*, was addressed through a combination of two intermediate results in Guatemala:

- Emergency Watershed Protection Implemented for Critical Sites (IR1.1)
- Local Capacity to Mitigate Future Storm Effects Strengthened (IR 1.3)

This work was undertaken by USDA in partnership with the Defenders of Nature Foundation (FDN or *Defensores de la Naturaleza* in Spanish), a Guatemalan non-governmental organization that manages the SMBR. FDN, with assistance from USDA, initiated watershed rehabilitation and vulnerability reduction activities in several key watersheds on the southern side of the *Sierra de las Minas* mountain range.

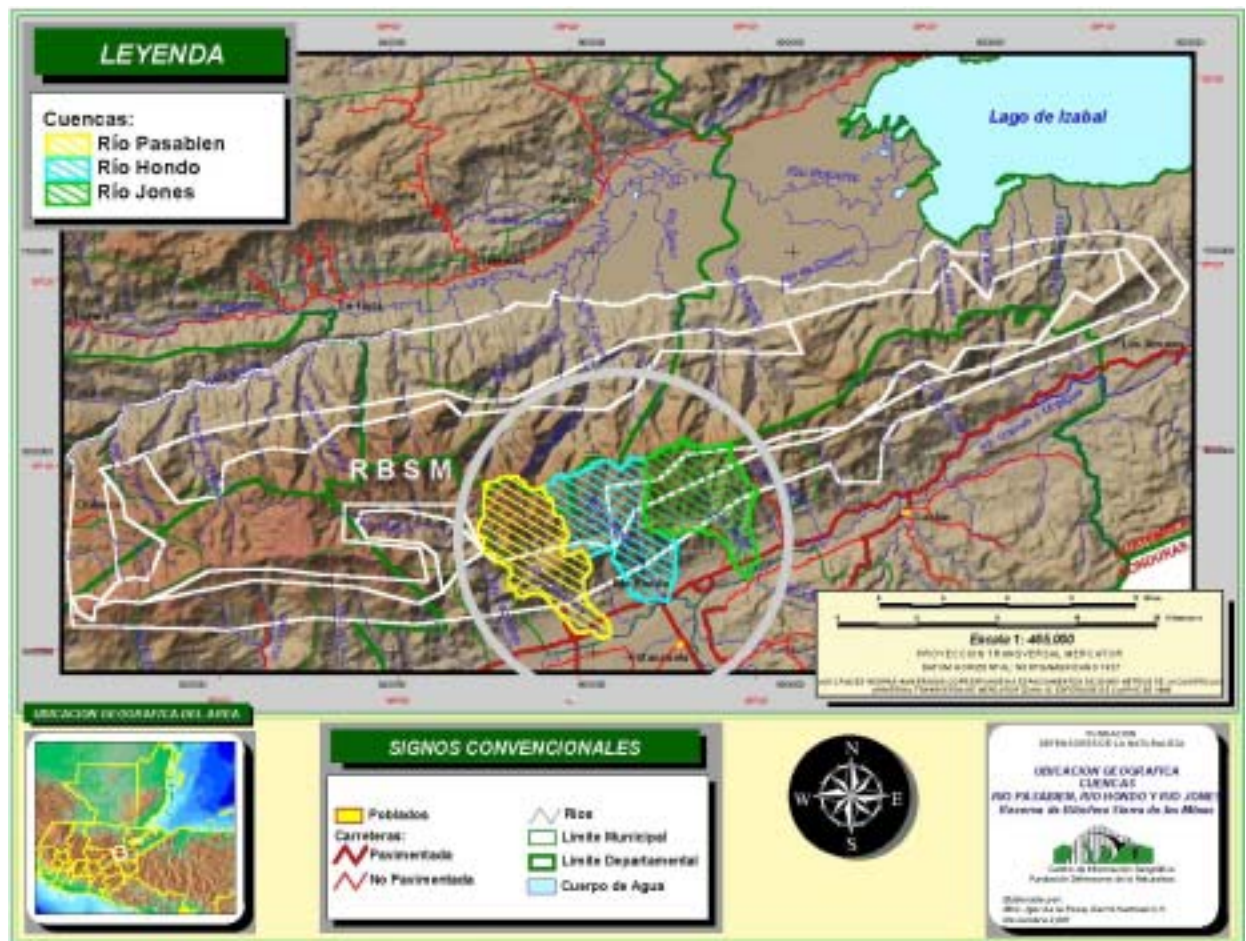
### **Planned Implementation Activities**

USDA and FDN's planned activities had four major components:

- Vulnerability reduction through the use of prescribed fire in the Jones, Rio Hondo and Pasabien watersheds
- Rehabilitation and stabilization of critical landslides
- Establishment of a baseline data collection system for fire and hydrological information.
- Reducing the impact of forest diseases and pests on SMBR conifers

Interventions were localized in the Jones, Rio Hondo and Pasabien watersheds situated on the south slope of the mountain range (figure 4).





**Figure 4. Target Watersheds (labeled as *cuencas* in the Spanish legend above) in the *Sierra de las Minas* Biosphere Reserve**

## Key Accomplishments/New Technologies

USDA’s in-country partner, *Fundacion Defensores de la Naturaleza* (FDN or “Defensores”) and the USDA Forest Service have enjoyed a unique relationship during the past ten years. The biosphere reserve was at one time designated a “Sister Forest” to a U.S. National Forest, which resulted in a variety of technical exchanges over the years between FDN staff and Forest Service technical specialists. USDA was able to build upon this existing relationship to jointly develop a viable Hurricane implementation plan for Guatemala. Key accomplishments according to project component follow.

**Key Accomplishment Component A:**

***Vulnerability reduction through the use of prescribed fire in the Jones, Rio Hondo and Pasabien watersheds.***

Between March and May of each year there are intense fires in SMBR started by farmers and cattlemen to clear land for forage production. Fires are particularly problematical along the southern slopes of the SMBR, and have reduced the ecosystem's capacity to absorb heavy rains, a primary factor in the severe damage experienced in the area during Mitch. FDN has documented a significant and worrisome reduction in forest cover in parts of the SMBR since 1987.

The project undertook a multi-faceted approach to reduce watershed vulnerability to wildfires that included an increase in the number of community-based fire brigades, a campaign to increase the level of fire awareness among communities and the development of a program of prescribed burning in order to mitigate the negative effects of wildfire. Accomplishments are in 6 specific areas:

**i. Prioritization of Critical Fire Areas**

FDN technicians and Forest Service staff jointly identified the South Sector of SMBR as the priority for fire vulnerability reduction activities based on 11 years of data collection by FDN, field excursions and technical discussions which considered biophysical, social, economic and cultural factors. The link between specific areas undergoing recurrent wildfire and Hurricane Mitch damage in the Motagua river valley immediately south of the reserve led to the selection of three rivers and their associated watersheds (Rio Jones, Rio Hondo and Rio Pasabien) encompassing an area of 27,381 hectares.

**ii. Training**

USDA Forest Service staff from New Mexico and Puerto Rico organized fire vulnerability reduction training into the following themes: 1) management of forest fires, 2) fire prevention techniques and 3) control and recovery of areas affected.

Accomplishments are summarized in Table 1 on the next page. Figure 5 on the following page shows a hands-on training session where fire is used as a tool to reduce fuel loading in a forested zone of SMBR. Such management fires reduce ecosystem vulnerability to devastating wildfires during the dry season.

## Fire Vulnerability Reduction Training

TOPIC	NUMBER OF EVENTS	NUMBER OF PARTICIPANTS TRAINED
<b>Year 2000 Forest Fire Season</b>		
Combat and prevention of forest fires	2	20
Fire detection systems	1	20
Fire management planning	9	12
Preventive measures	11	12
Extinguishing forest fires	24	12
Systems of monitoring areas affected by fire	1	12
<b>Year 2001 Forest Fire Season</b>		
Techniques of fire prevention and prescribed burning	14	15
Preventing forest fires (for community leaders)	1	20
Fire management planning for 2001	1	2
Combating forest fires	4	76
First Aid	1	80
Creating fuel breaks using fire (“black lines”)	15	76

**Table 1. Summary of fire training accomplishments**



**Figure 5. Training in the use of fire as a tool to reduce vulnerability to uncontrolled forest fires**

### **iii. Prevention**

A number of fire prevention activities were instituted during the project, which increased the capacity of the SMBR to detect, prevent, and contain fires. These activities are summarized in Table 2 on the next page, including the creation of fire breaks and the construction of fire towers to assist with the timely discovery of wildfires. Firebreaks were particularly important in establishing a physical barrier between lower elevation wildfires originating in agricultural zones and the upper areas of the watersheds where wildfires can degrade vulnerable ecological zones performing critical watershed functions. Figure 6 shows the construction of a firebreak by a fire crew utilizing hand tools. Prescribed burning is a new technology that USDA has brought to the SMBR which should greatly reduce the impact of wildfires in this part of Guatemala.



ACTIVITIES	YEAR 2000	YEAR 2001
Fire detection	3 fire watch towers constructed	
Fire lines and fuel breaks	6,000 linear meters constructed	23,000 linear meters constructed
Creating fuel breaks using fire (“black lines”)	60,000 square meters established	230,000 square meters established
Prescribed burns undertaken with communities		37 events resulting in 217 hectares burned

**Table 2. Summary of fire prevention activities during the project**



## **Brechas Corta Fuegos**

**Figure 6. Construction of firebreak using hand tools**

#### iv. Control and management of fires

Both technical and financial assistance from USDA allowed the deployment of mobile crews of trained firefighters to high-risk zones during the dry period of the year when most fires occur. Monitoring of fire was undertaken during this period 7 days a week, including holidays. Wildfire statistics indicate that during 2001 there was a large decrease in land area affected by forest fires. This took place after training activities and the outfitting of fire brigades had been completed in 2000. While 2000 was a bad fire year, the decrease in 2001 was much greater than that experienced in 1999 after the 1998 fire year. Table 3 provides wildfire statistics since 1998 and lists the causes of wildfires during 2001.

Watershed	1998 (# ha)	1999 (# ha)	2000 (# ha)	2001 (# ha)	Causes of forest fires during 2001 (percent)		
					Land clearing	Livestock forage	Hunting activities
Rio Pasabien	3,225	533	3,819	546	35%	38%	27%
Rio Hondo	3,763	472	2,883	186	60%	30%	10%
Rio Jones	4,089	1,327	2,547	539	10%	80%	10%

**Table 3. Areas affected by forest fires: 1998-2001**

#### v. Design and Implementation of a Fire Management Plan

With technical assistance from USDA on the fire management planning process (begun by Forest Service employee Eduardo Encinas) an operational plan was developed aimed at the target zones of the project (which are some of the worst fire-affected areas in Guatemala). The plan will be expanded over time to cover the entire reserve. The plan contains the following components:

##### **Prevention**

- Education and extension--use of extension chats, meetings, videos, radio, and trainings regarding prevention and control of wildfires
- Legal--consultations with local authorities to strengthen application of existing laws
- Preventing forest fires through prescribed burning

##### **Control**

- Identification of fires through patrols and vigilance
- Combating wildfires
- Establishing strategic alliances for fire prevention and control
- Monitoring the effects of fire on SMBR

## **vi. Extension**

A wide variety of extension methods were utilized to promote fire prevention behaviors (as well as educate the public about other aspects of the project and SMBR) in the various communities and households in the area. These included use of radio programs, workshops, community meetings, and television. One highlight was the production of a video focused on the issue of fire in SMBR. This video entitled “Los Incendios se Apagan con el Invierno.” (Fires Go Out With the Winter) provides an excellent overview of the problem of fires in SMBR and how FDN and USDA have worked together to reduce the incidence and severity of fire.

### **Key Accomplishment Component B**

#### ***Rehabilitation and stabilization of critical landslides***

Hurricane Mitch caused thousands of damaging landslides throughout Central America. Landslides cause both immediate damage and serve as a source for ongoing damage with subsequent storms because soil, gravel, and even boulders can continue to move downward through a watershed (via watercourses) causing flooding and negatively affecting water quality. USDA’s approach in this component was a combination of technical assessment, training, implementation, monitoring, and extension. These are briefly summarized below.

## **i. Training**

Early during the project, USDA sponsored a study tour to the Caribbean National Forest (El Yunque District) in Puerto Rico to train Defensores staff how to stabilize and rehabilitate landslides. USDA Forest Service staff were well qualified for this task by virtue of similar work they have done in recent years during Hurricane Georges and other devastating hurricanes. Furthermore, Caribbean National Forest staff followed up with periodic trips to Guatemala to provide hands-on guidance in this work. In the field USDA staff provided specific training to identify local materials to construct stabilization structures as well as herbaceous, shrub, and tree species to use in rehabilitating landslides.

## **ii. Characterization of critical areas**

USDA guided the process of identifying areas with the greatest impact from landslides and put together a two-year plan of rehabilitation for the Rio Colorado and Rio Blanco sub-watersheds. Landslide impact of community water supplies was a major factor in determining which of hundreds of landslides should be treated. A manual for the management of landslides was produced.

### iii. Treatment of landslides

During 2000 a total of 69 landslides were treated. During 2001, 14 additional slides of much larger average dimensions were treated while the slides from 2000 were monitored and maintained. During the two years, an area covering 65 hectares was treated benefiting an area of 9,287 hectares (see table 4 below).

SIZE OF SLIDES TREATED (SQUARE METERS)	NUMBER OF SLIDES	TREATMENTS APPLIED			
		Walls	Staked Retaining Walls	Drainage	Revegetation
0-1000	33	32	17	25	30
1000-2000	12	14	7	11	10
2000-3000	14	16	9	12	10
3000-4000	4	5	2	3	3
5000-6000	5	12	1	5	5
6000-25000	11	8	1	5	11
25000 Y + M2	3				
		9287 hectares treated			

**Table 4. Summary of landslide treatments in the Rio Jones and Rio Blanco watersheds**

Various techniques were applied in the stabilization and rehabilitation of landslides. These included:

- **Retention of sediment**—At the base of landslides retaining walls were constructed of local materials to prevent movement of sediment from the base of the slide. This was either constructed of rock or wooden stockades which were available in the immediate vicinity of the landslide (figure 7).
- **Establishing drainage**--Cut-off drains were established above each landslide so that during rain storms run-off moving down slope would be minimized across each landslide. This had the effect of reducing the propensity of further movement.
- **Gabions**--Stone-filled baskets to hold back soil and debris.
- **Revegetation**--Seeding and planting of portions of the slides with suitable plants was undertaken to stabilize areas by root development holding soil and through the



development of vegetation which can intercept rainfall and reduce surface erosion. Species utilized included pines (*Pinus oocarpa*), oaks (*Quercus acatenagensis* and (*Quercus penducularis*), as well as *Cedrela mexicana*, *Inga sp.*, and *Liquidambar styracyflua*.

- **Maintenance**--Maintenance is important to repair minor breaches in retaining walls and reseed bare areas.

Figure 7 below is an example of a several small landslides stabilized in the SMBR. Note that the slide is situated in a draw which will more rapidly lead to sediment entering watercourses during rainfall events if left untreated.



**Figure 7. Example of a landslide treated through construction of retaining walls using local materials**

#### **iv. Extension**

Two workshops were held on this topic, one in July 2000 and another in July of 2001. Defensores used these workshops to educate local stakeholders and government officials regarding the importance of watershed management and why the work on stabilizing landslides can provide important benefits to local communities in terms of improved water quality and reduction of damage to agricultural operations.

#### **Key Accomplishment Component C**

##### ***Establishment of a baseline data collection system for fire and hydrological information***

This project component had three main sub-components:

- Installation of weather stations
- Characterization of individual watersheds and study of the livestock situation in the Jones watershed
- Water quality monitoring in target watersheds as well as other points of interest in SMBR

A fourth activity (listed below) was added in 2001 due to concerns about bark beetles and pathogenic diseases attacking trees.

- Reducing insect and disease problems in conifers within SMBR

#### **i. Installation of weather stations**

An important component of USDA's assistance was the financing and technical training associated with the installation of modern field weather stations. Three stations were installed resulting in an important contribution to Guatemala's weather monitoring capabilities, since the SMBR is one of the most important sources of water for southeastern Guatemala. Collecting weather data is allowing improved ability to document hydrological function and will enhance the ability of Guatemalan authorities to link rainfall events with flooding potential thus reducing vulnerability in local communities lower in the watershed. In addition, weather monitoring is very important in fire management, since rainfall, humidity, wind speed, etc. are all very important in predicting fire hazard and are useful in determining when conditions are optimum for prescribed burning.

**New technology**—The weather stations selected were those recommended for use by the U.S. Forest Service and include automated data recording and satellite links by radio. It was necessary to send Forest Service technical specialists to Guatemala to assemble the stations from their component parts and provide training to FDN staff in the use and maintenance of the stations. The equipment was purchased from Campbell Scientific in the US and was model CRX10 (figure 8).



**Figure 8. Campbell Scientific weather station installed at SMBR.**

**ii. Characterization of individual watersheds and study of the livestock situation in the Jones watershed**

A characterization of the Rio Hondo, Pasabien, and Jones watersheds was completed during the project in order to establish a baseline data resource from which change can be detected. This resource will help FDN better understand both the social as well as ecological factors at play within the watersheds. This characterization covered an area of 27,381 hectares and included social components (population data, land ownership, occupations, etc.) and a biophysical component (physical delineation of the watershed, soils, geology, vegetation, wildlife, hydrology, etc.).

In addition, a study of the livestock situation in the Jones watershed was completed and is available as a separate report. The close link between livestock husbandry and wildfires is such that detailed understanding of livestock operations within the watershed was felt to be an important step necessary to understand the social dimension of wildfires. This report contains detailed information on livestock ownership, livestock numbers, location of pastures, and so forth.

### **iii. Water quality monitoring**

The project undertook monitoring of water quality and quantity at a number of strategic points in the target watersheds with field water testing kits provided by the project. Such characteristics as sediment levels, pH, conductivity, salinity, dissolved oxygen, and nitrates levels (among other characteristics) were periodically tested. Main findings were that water from higher elevations is of higher quality than of those lower and that overall the water is low in contaminants. Use of modern water testing equipment was another example of new technology transfer that was realized by the project.

### **iv. Reducing insect and disease problems in conifers within SMBR**

Monitoring of bark beetle populations and the incidence of forest diseases was undertaken during the project. The Hurricane and periodic wildfires have created conditions which can favor the outbreak of pest and disease epidemics. Bark beetles in particular have the potential, under certain conditions, to undertake mass attacks and have been known to kill thousands of trees in a very short period. This then creates a high-risk fire situation.

Dr. Ron Billings of the Texas Forest Service (a world expert on the southern pine beetle) undertook a diagnostic visit to SMBR with the aim of enhancing the capability of FDN to monitor populations and control small outbreaks at an early stage. It was determined that forest diseases (particularly mistletoe) do not at present constitute a serious menace to the SMBR.

## **Strengthening Host Counterpart Organizations**

USDA's approach in Guatemala, as elsewhere, was to maximize the utility of its budget by augmenting the work of on-the-ground organizations having an established field presence and direct links to communities. This took place by direct funding of field activities through grant agreements and by providing technical assistance from specialists from USDA. This ensured that a significant share of USDA's Hurricane resources went to actual rehabilitation work in the field.

USDA's in-country partner, *Fundacion Defensores de la Naturaleza* (FDN) was the main USDA partner in the Guatemala effort. FDN, however, involved many other local NGOs, municipal authorities, and communities in this effort by virtue of the fact that they are legally mandated to manage this large and important Biosphere Reserve. In addition, there are a number of Peace Corps Volunteers that were assigned to work with FDN at this site as their primary Peace Corps assignment, thus it can be said that the Peace Corps was also a partner.

As was mentioned in the introduction, the USDA Forest Service has enjoyed a unique relationship with FDN during the past ten years through prior collaboration under the "Sister Forest" program, which resulted in a variety of technical exchanges over the years between FDN staff and Forest Service technical specialists. USDA was able to build upon this existing



relationship to rapidly develop a strong collaborative relationship.

FND maintains what is essentially a permanent presence as probably the best-known and most capable environmental organization within Guatemala today. They have a cadre of supporters who maintain membership status (both Guatemalans and foreigners) by supporting FND via annual dues. In addition, they undertake development and conservation activities on a regular basis with various donors for communities in the buffer zone of SMBR and thus have the financial resources to hire and support staff, maintain offices, and finance vehicles. They are well positioned to carry on their work for a long time to come.

***USDA Forest Service is recognized by FND for its contributions***

On November 29, 2001 the USDA Forest Service was awarded the *Pin de Oro* (Gold Pin) by Defensores. This prestigious award is given to an individual or organization that makes a significant contribution to natural resource conservation in Guatemala. Prior winners of the award include the Nature Conservancy and the Peace Corps. The award was presented to the USDA Forest Service in recognition of contributions Forest Service staff made to the work of Defensores. Forest Service employees Paul Schmidtke (Lincoln National Forest) and Luis Rivera (Caribbean National Forest) attended the ceremony in Guatemala City and accepted the award on behalf of all Forest Service employees (figure 9).



**Figure 9. Forest Service employee Paul Schmidtke receiving the *Pin de Oro* from *Fundacion Defensores de la Naturaleza* in Guatemala City**

## **Practical Impact of USDA's Assistance**

Environmental vulnerability to future storms was reduced in the Rio Hondo, Rio Jones, and Rio Pasabien watersheds by the stabilization of 82 landslides.

The incidence of wildlife in the SMBR was dramatically reduced in 2001.

FDN now has the ability to undertake in a safe and effective manner prescribed burning and other fuel reduction techniques which should reduce the vulnerability of SMBR to future wildfires and hurricanes.

A fire video was produced which can be used as an effective extension tool in schools and communities to educate Guatemalans on the fire management programs of FDN and the importance of reducing fire incidence in the SMBR.

Three modern weather stations linked to the national weather monitoring network will increase dramatically weather data collection in the SMBR which can be used to improve fire management activities as well as improve watershed analysis and monitoring capabilities. .

The level of consciousness was raised on behalf of area residents regarding the importance of SMBR and the hazards of wildfires.

The generation of income through work opportunities provided by the project (firefighting and landslide stabilization) stimulated the local economy and fomented greater stability among the residents.

Local organizations and institutions were strengthened.

Technical cooperation between the USDA Forest Service and FDN was reinvigorated and should stimulate ongoing technical cooperation between USDA technical staff and technical staff of FDN.

## **Additional Measures to Protect the Investment/Recurring Costs**

USDA's resources resulted in the establishment of physical works (landslide stabilization structures), the purchase of equipment (weather stations, water testing, fire fighting), the development of technical approaches (fire management, hydrological monitoring, etc), and the training of FDN staff to manage these various activities into the future.

While environmental NGOs always can use financial support, FDN is strong and stable enough that there is no question as to their capacity to continue indefinitely without additional USDA assistance. Since USDA through the Forest Service and FDN had a technical relationship before Hurricane Mitch, it is very desirable that technical exchanges continue in the future. There is no reason why this cannot continue, building upon the new personal and professional relationships developed and strengthened over the past two years.

## **Other Activities to Consider to Mitigate Future Disasters**

Although the area of watershed treated was significant, there still remain many additional areas of vulnerability on steep slopes that could be treated if resources were available. It is hoped that FDN will be able to build upon the Hurricane Mitch experience with USDA to engage other donors in similar activities.

**Budget for the Guatemala HMRP:                   US\$ 400,119**